



#### **Presentation Outline**

Topic	Presenter
Introduction	Michael Sivak, USEPA
Site Overview and Background	Diane Salkie, USEPA
Remedial Investigation/Conceptual Site Model	Ed Garland, HDR
Risk Assessment Summary	Chuck Nace, USEPA
Feasibility Study/Interim Remedy	Diane Salkie, USEPA
Interim Remedy Completion	Andy Bullard, CDM Smith and Dr. John Kern, KSS
Adaptive Management	Michael Sivak, USEPA
Closing Remarks	Michael Sivak, USEPA



#### A couple of quick notes...

- The Draft Feasibility Study was prepared by the Cooperating Parties Group and submitted in August, September and October 2019.
- EPA has numerous comments on the document.





# Region 2 is requesting CSTAG's feedback on the following items:

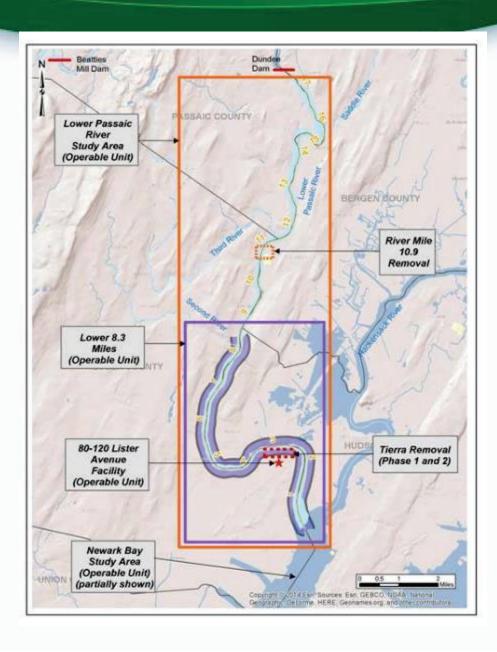
- 1. IR FS alternatives
- 2. Proposed IR details
- 3. Adaptive management
- 4. Determination of IR completion



### **Site Overview and Background**







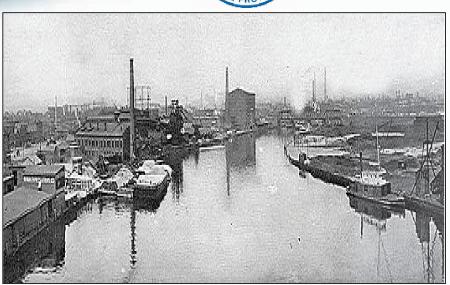
# Diamond Alkali Superfund Site Overview:

- 80-120 Lister Avenue, OU1
- Lower 8.3 miles of the
   Lower Passaic River, OU2
- Newark Bay Study Area, OU3
  - 17-Mile LowerPassaic River StudyArea, OU4



#### **Lower Passaic River History**

- 1800s: Major center of Industrial Revolution
- Until 1970s, discharge of wastewaters into river was common practice
- Over 100 industrial facilities potentially responsible for sending contaminants into river
- Navigation channel built in late 1800, maintained until 1950s to 1983
- Industrial discharges & filling in of channel resulted in large inventory of contaminated sediment







#### **Diamond Alkali Superfund Site History**

**1984:** EPA lists Diamond Alkali Superfund Site as a NPL site

**1987:** Interim ROD for containment remedy <u>including</u> the following at 80-120 Lister Avenue facility:

- capping,
- subsurface slurry walls, and
- a groundwater collection and treatment system



Mid-1980s: Occidental under agreement with the State of NJ determined that dioxin was in the river adjacent to their facility



**1994:** Occidental and EPA signed an agreement to investigate the River

**By 2002,** EPA expanded investigation to 17-mile tidal portion of the river



#### **Timeline for Site Investigations**

2004 to 2007: EPA RI/FS sampling of 17-miles

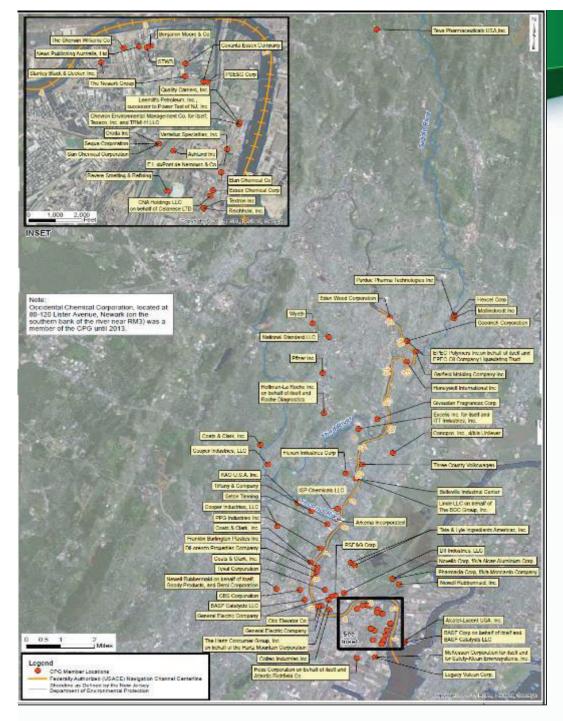
**2007:** Cooperating Parties Group (CPG) agrees to take over on-going 17-Mile RI/FS

2008 to 2014: CPG conducts RI sampling

**2014 to now:** data evaluations, analysis, report prep

## RI Field Investigations Included:

- Bathymetry Surveys
- Water Column Sampling
- Sediment Sampling
- Biological Sampling

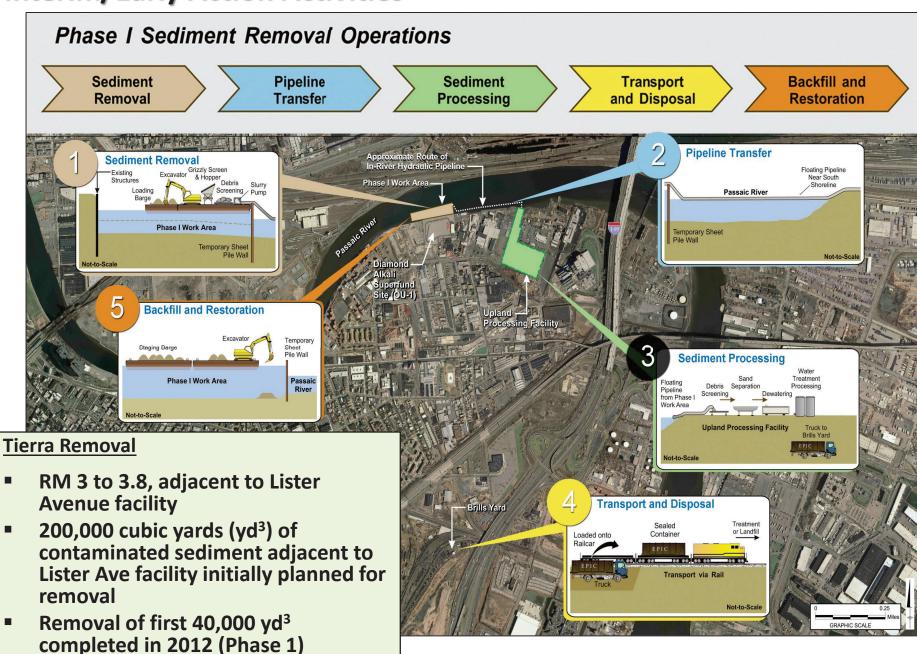




# Historic Contaminant Sources & Distribution

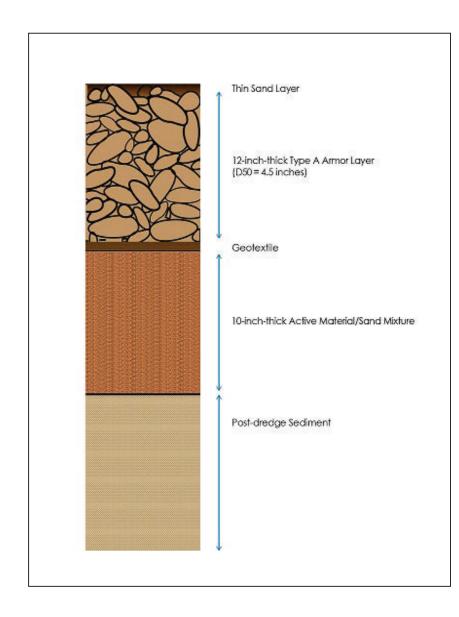
- Over 100 PRPs identified throughout LPRSA
- 80-120 Lister Avenue facility
- Additional contaminant sources included:
  - untreated industrial and municipal wastewater
  - CSOs/SWOs
  - direct runoff
  - atmospheric deposition, etc.
  - tributaries, Upper Passaic River,
     Newark Bay

#### **Interim/Early Action Activities**



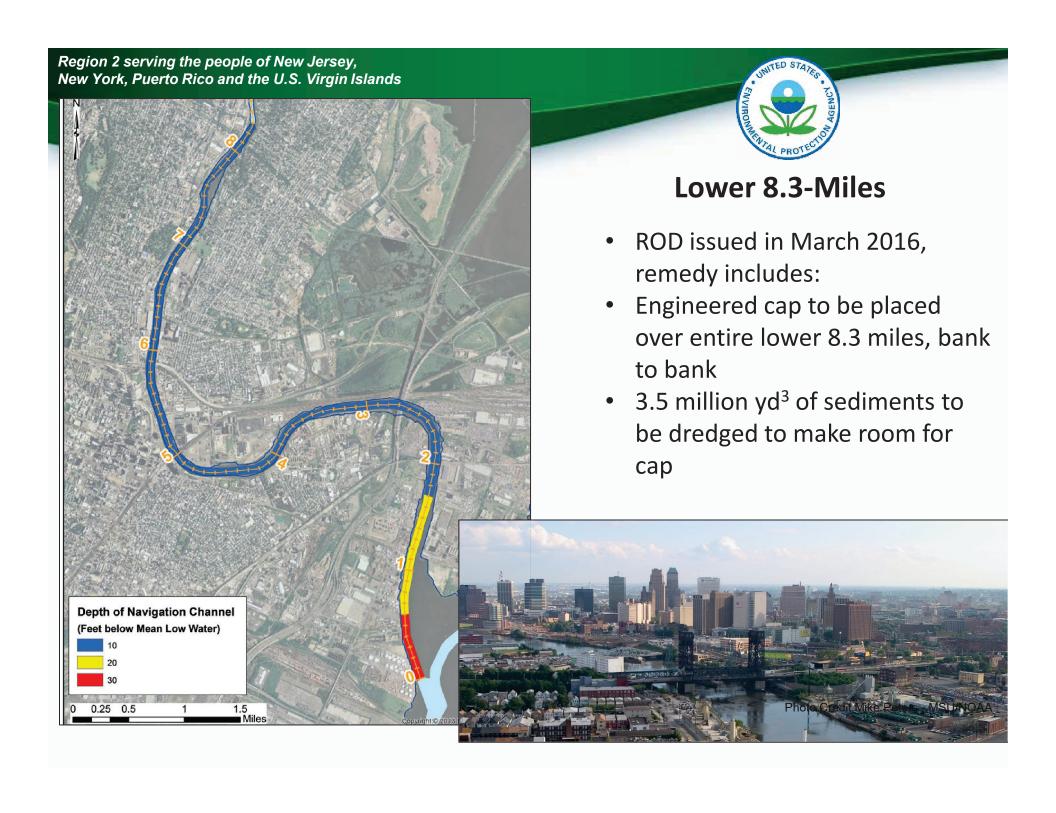
#### **Interim/Early Action Activities**

#### **River Mile 10.9 Removal**











#### **Community Involvement Coordination**

# Passaic River Community Advisory Group (CAG) is made up of:

- Local Residents
- Environmental Groups
- Local Government Representatives

#### **CAG** currently meets bi-monthly:

#### **EPA** briefs the CAG on all major activities such as:

- Planned site sampling events
- River mile 10.9 removal action
- Lower 8.3 mile remedy
- Upper 9 mile proposed interim remedy

#### **EPA** maintains public web site ourpassaic.org to:

- Post fish and crab consumption advisories
- Inform public of ongoing activities
- Provide CAG meeting schedule
- Provide access to site documents and data

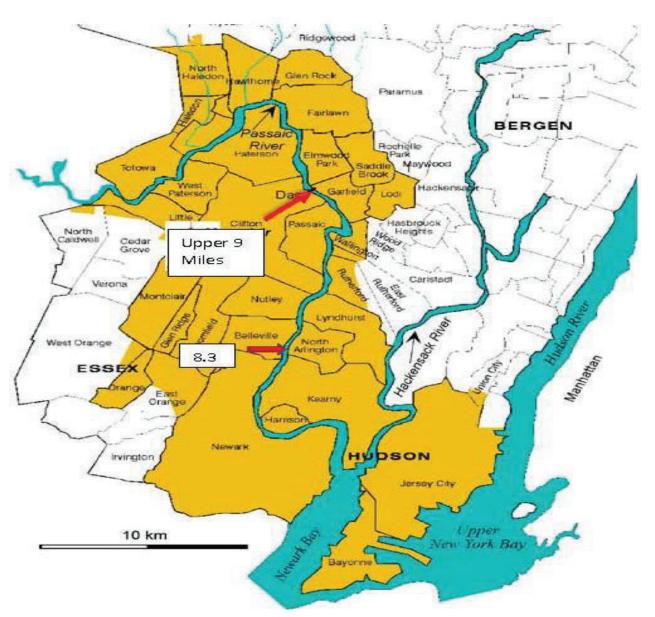


#### **Community Involvement Coordination**

#### **Interim Remedy Briefings**

- April 23,2019 Briefed local, state and federal public officials in the upper 9 miles on the interim remedy in Lyndhurst, NJ
- July 25, 2019 Held public availability session with NJ Assemblywoman in Clifton, NJ about interim remedy
- October 21, 2019 Held second public availability session in Rutherford, NJ

#### **Communities along the Upper 9 Miles**





#### **Coordination with Partner Agencies**





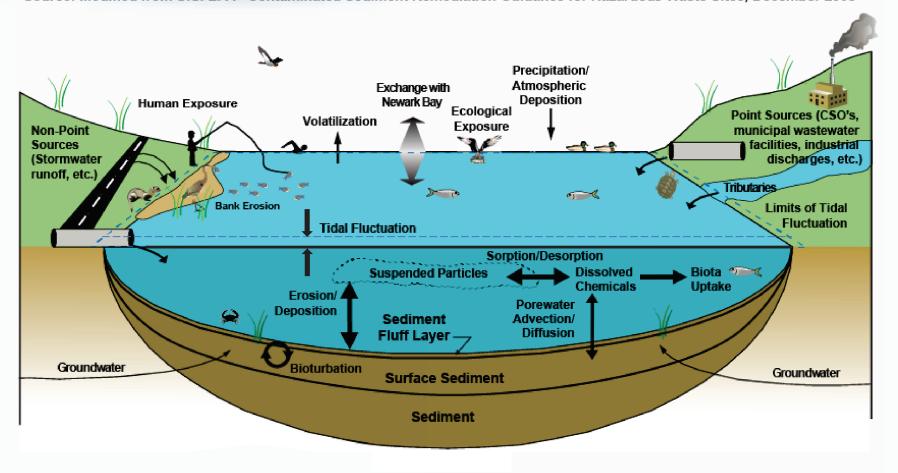
- EPA provides updates on CPG investigations and reporting
- PAs are invited to provide comments on CPG deliverables for EPA consideration
- EPA meets with PAs to discuss key topics such as:
  - COPC mapping
  - River mile 10.9 removal.
  - Human health and ecological risk assessments
  - CPG's proposed interim remedy



# 17-mile LPRSA Remedial Investigation (RI) and Conceptual Site Model (CSM) Summary

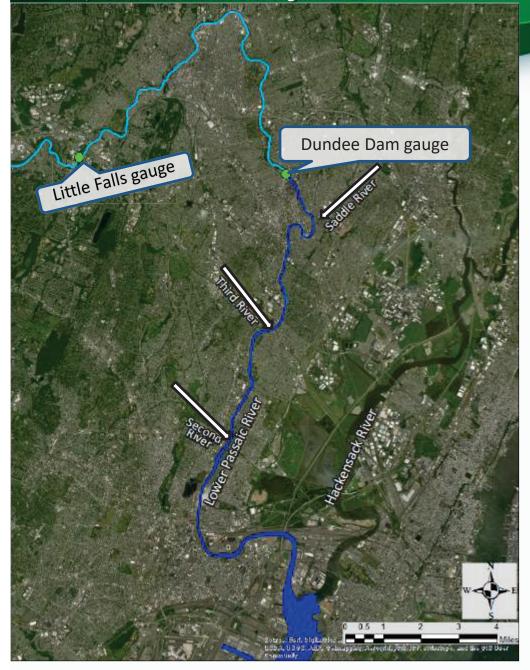


Source: Modified from U.S. EPA - Contaminated Sediment Remediation Guidance for Hazardous Waste Sites, December 2005





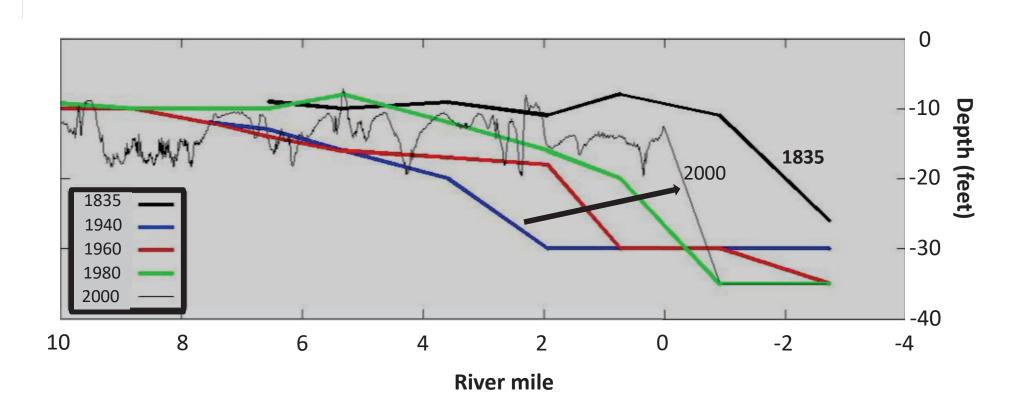
Region 2 serving the people of New Jersey, New York, Puerto Rico and the U.S. Virgin Islands





Flow Input	Average Flow (cfs)
Dundee Dam	1,315
Saddle River	117
Third River	12
Second River	15
LPR CSO/SW	16

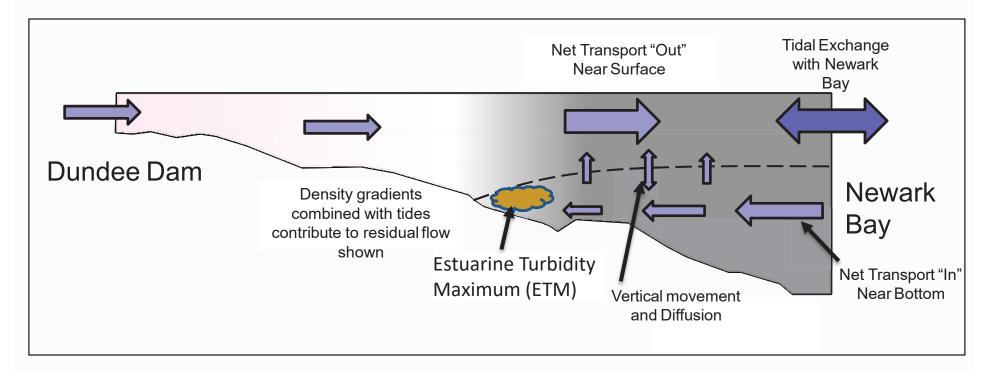


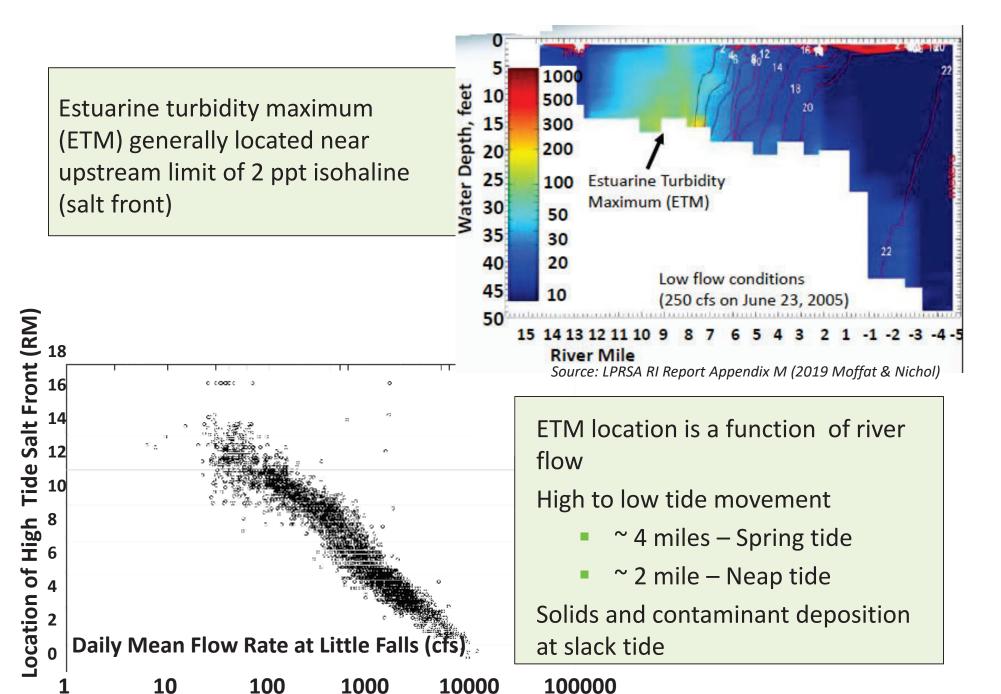


Source: Chant and Fugate, 2006



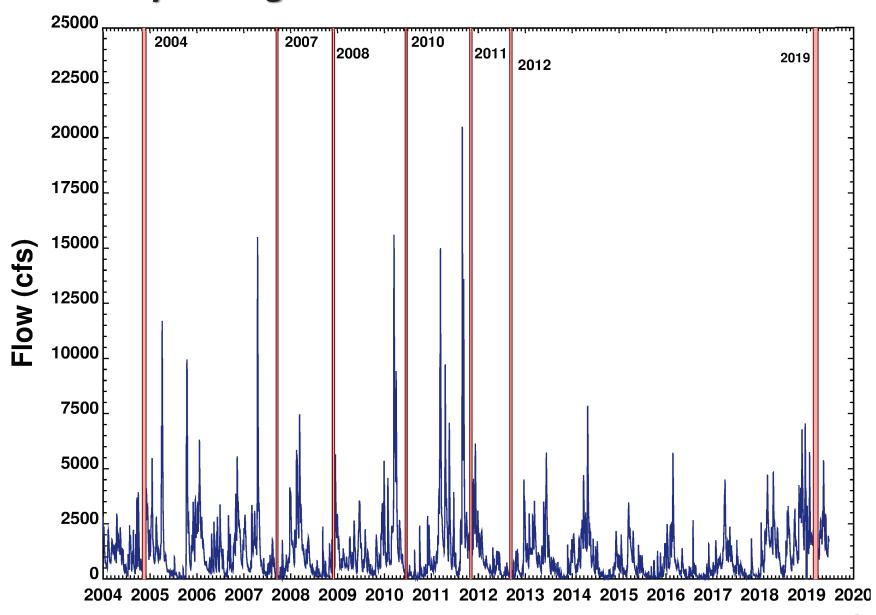
#### **Example of Water Circulation in the Lower Passaic River**





Source: LPR System Understanding of Sediment Transport (2011 SEI & HDR)

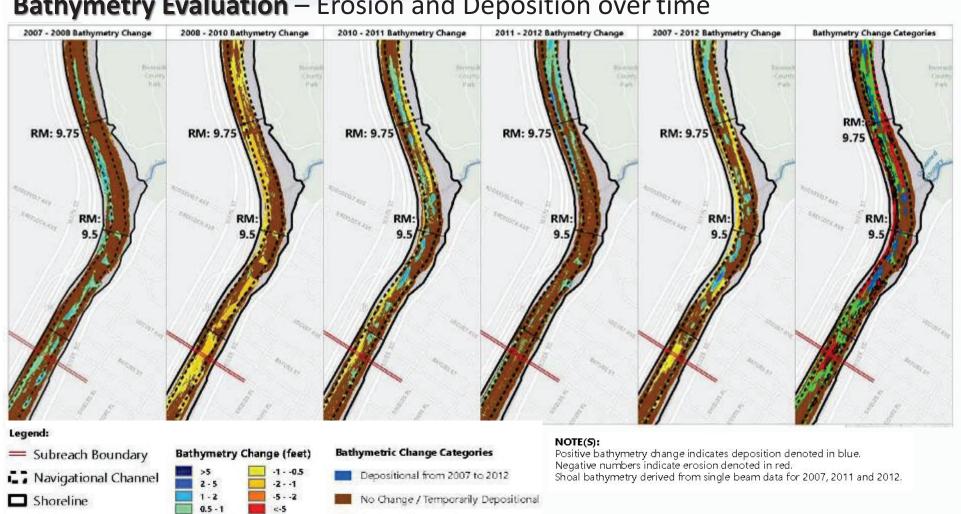
#### Daily Average Flows at Little Falls 2004 – 2019



Source: LPRSA RI Report (2019 Anchor QEA)



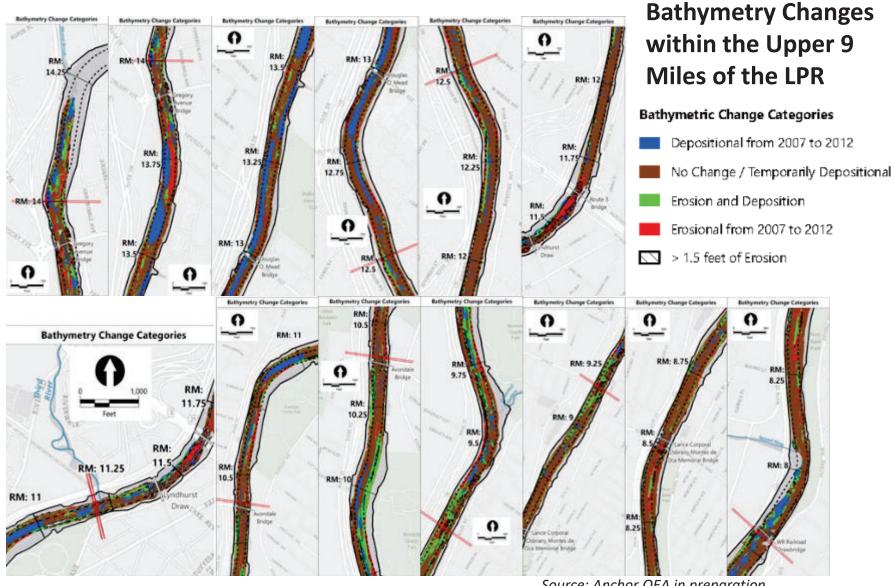
#### Bathymetry Evaluation – Erosion and Deposition over time



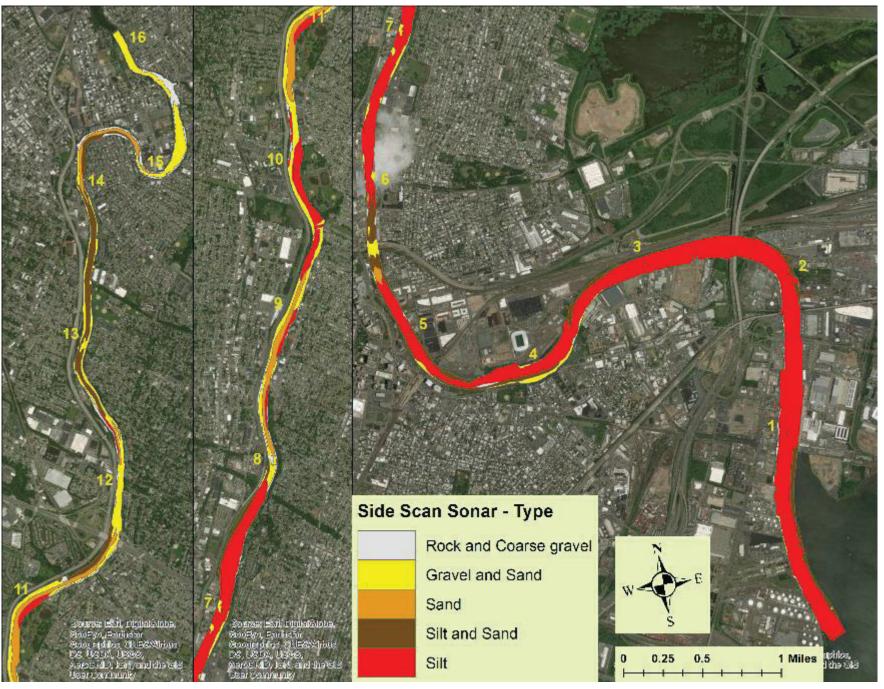
Erosion and Deposition Erosional from 2007 to 2012

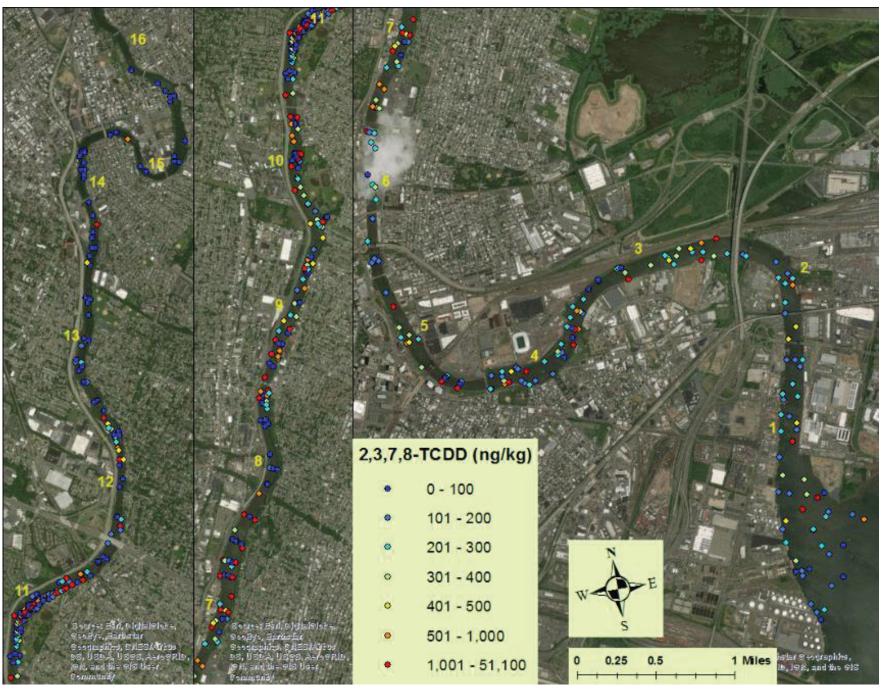
> 1.5 feet of Erosion

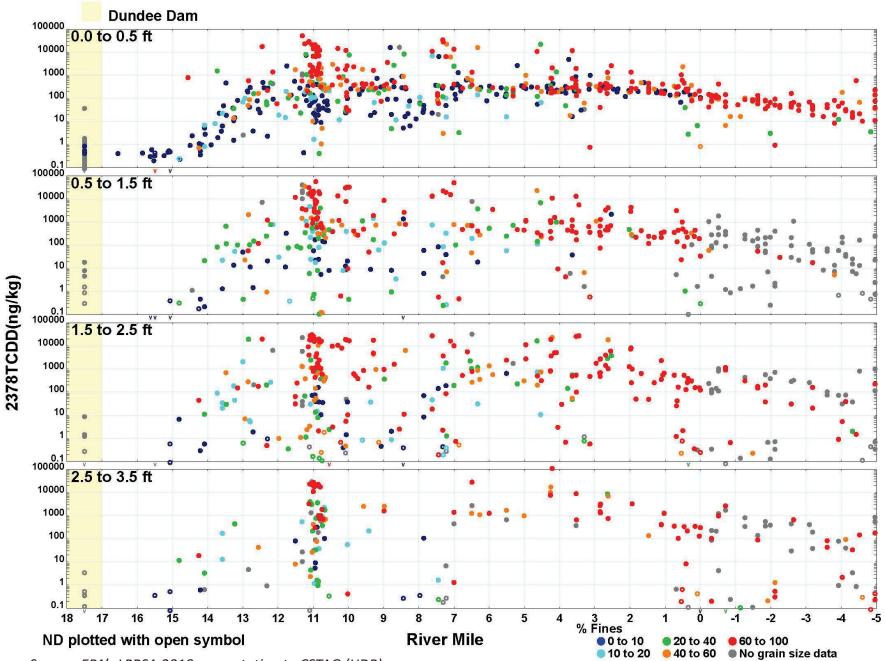
#### **Sediment Deposition and Erosion**



Source: Anchor QEA in preparation









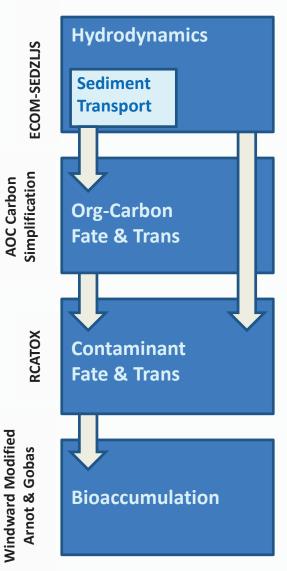
#### **Contaminant Concentration and Particle Size Trends**

- Lower 8-mile surface sediments are primarily fines
- Upper 9-mile surface sediments are generally coarser than lower 8
  - Fines distributed in low energy areas and smaller, discontinuous pockets
- Most COPCs show some correlations with fines
  - TCDD shows strongest correlation
  - DDx, total PCB, and mercury correlations not as strong as TCDD
  - PAHs show elevated concentrations across range of grain sizes
- Most COPCs have decreasing concentrations above ~RM 13
  - Low flows needed for density-driven currents to get upstream of RM 13
  - Velocities are greater upstream of RM 13, resulting in erosion of fines and overall coarse substrate
- As part of the RD, additional sampling will be needed to inform any detailed remedy or interim action design
  - CPG has discussed potentially using a 80 ft triangular grid



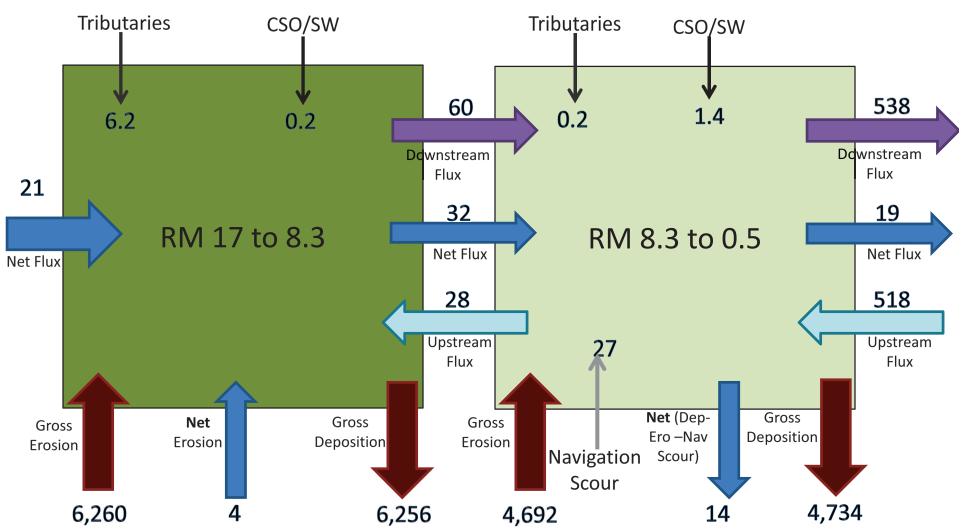
#### **Model Structure for 17-mile RI/FS**

- EPA team developed models for Lower 8-mi Focused
  Feasibility Study and transferred to CPG for 17-mile RI/FS
  (hydrodynamic, sediment transport (HST), organic carbon
  (OC) fate and transport, contaminant fate and transport
  (CFT)
- CPG modifications:
  - Additional sediment size classes to ST model
  - Eliminated algal growth and death kinetics in OC model
  - Added reversible and resistant partitioning to CFT
  - Added fluff layer to CFT model
- CPG using bioaccumulation model (Arnot and Gobas approach) rather than empirical relationships (non-linear BSAFs).



#### External and Internal Solids Movement (1996 – 2013)

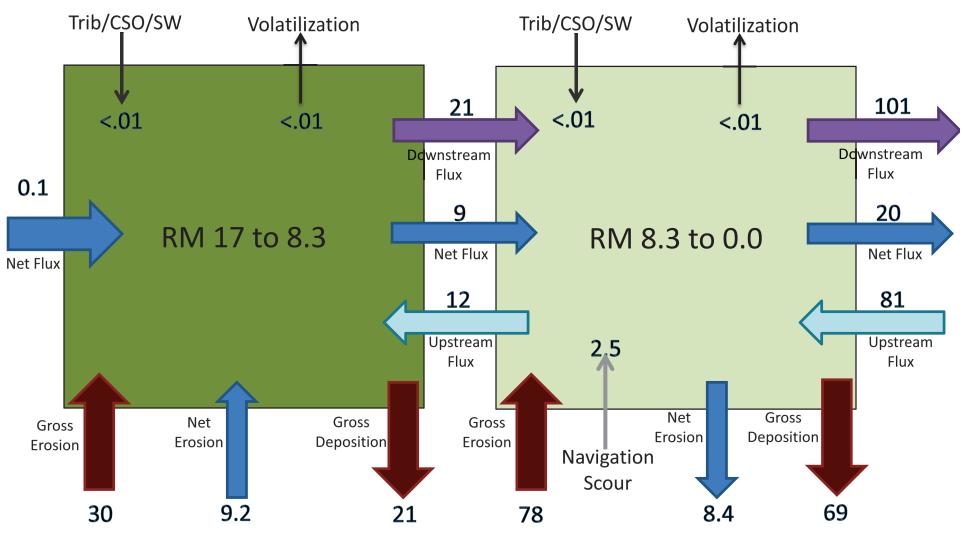
#### 1000 MT/Yr



Source: Values from LPRSA RI Report Appendix M (2019 Moffat & Nichol); graphic prepared for EPA's LPRSA 2019 presentation to CSTAG (HDR)

#### External & Internal 2,3,7,8-TCDD Movement (1996 – 2013)

#### grams/Yr



Source: Values from LPRSA RI Report (2019 Anchor QEA); graphic prepared for EPA's LPRSA 2019 presentation to CSTAG (HDR)



#### **Ongoing Contaminant Sources**

- Primary Source
  - Internal sediment inventory
    - e.g., resuspended contaminated sediments within the LPR
    - contaminants generally associated with fines
- Secondary Sources
  - Tidal exchange with Newark Bay
  - Flows from above Dundee Dam
- Minor Sources
  - CSOs/SWOs, direct runoff, tributaries, atmospheric deposition, etc.



#### **CSM & RI Summary**

- Navigation dredging and subsequent infilling created a "settling basin" for solids and contaminants
- Estuarine circulation enhances retention of solids and contaminants
- Estuarine circulation transports resuspended solids and contaminants over long stretches of the LPR
  - Function of freshwater flow and daily tidal excursions (high low tide)
- Data collected over last decade reflect effects of relatively rare flow conditions
- Sequential bathymetry surveys document response of sediment bed to varying flow conditions
- Primary source of contaminant inputs to the water column is resuspension of in-place sediments

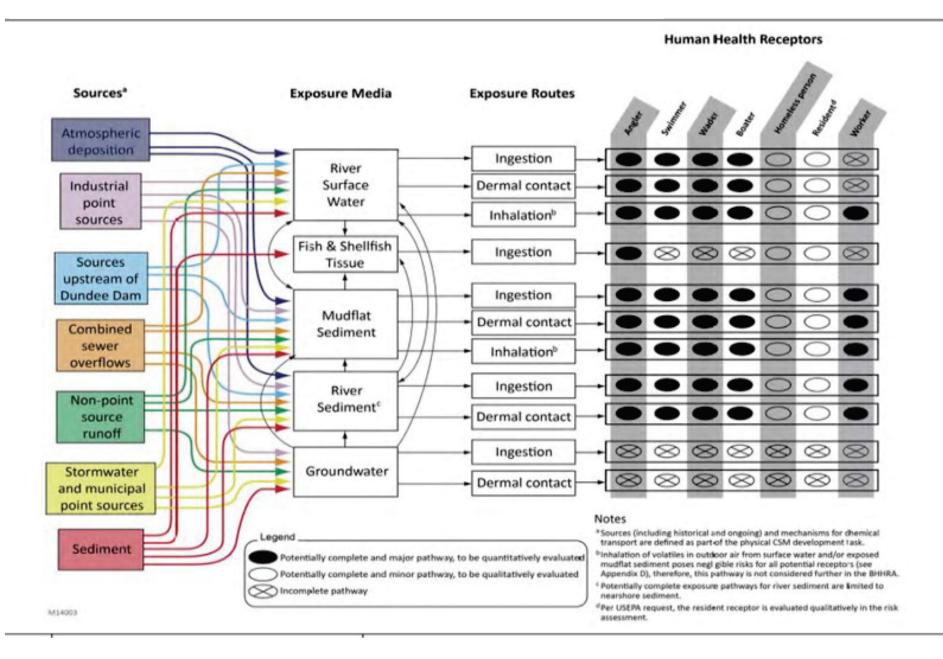


# Overview of Human Health and Ecological Risks





### General Human Health CSM (AECOM 2017)





#### **Human Health Risk Assessment - Conclusions**

- Chemicals of Concern: primarily dioxins and PCBs
- Receptors: young child, adolescent, and adult
- **Fish**: fillets of common carp, white perch, American eel, catfish, and largemouth/smallmouth bass
- **Crab**: muscle and hepatopancreas

Receptors	Cancer Risks	Non-Cancer Hazards	Cancer Risks	Non-Cancer Hazards	
	Fish Cons	sumption	Crab Con	sumption	
Young Child	1 x 10-3	193	4 x 10-4	50	
Adolescent	2 x 10-3	127	5 x 10-4	33	
Adult	3 x 10-3	123	9 x 10-4	32	
Adult/Child	4 x 10-3		1 x 10-3		

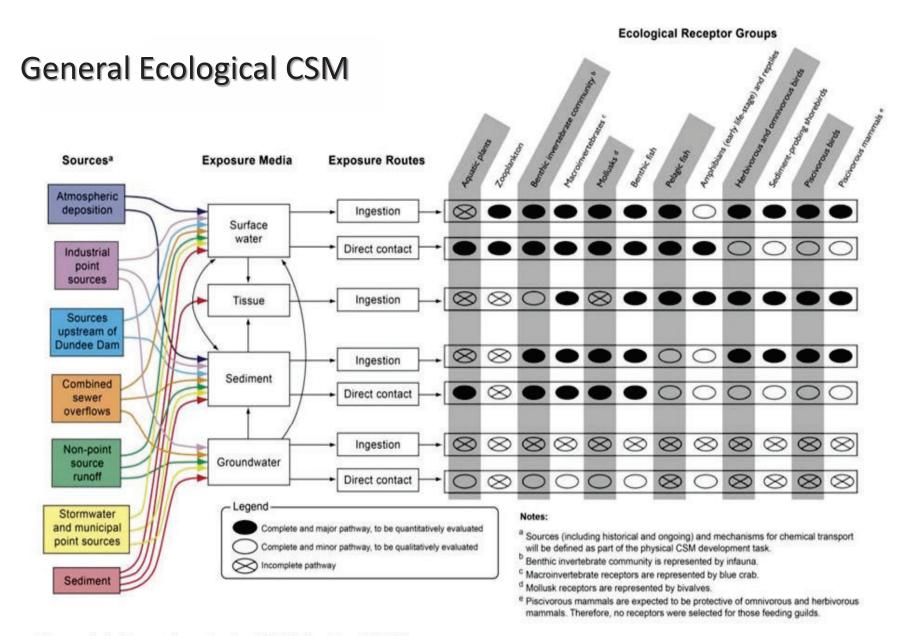


Figure 3-1. General ecological CSM for the LPRSA



# **Ecological Risk**

- Baseline Ecological Risk Assessment approved by EPA 7/2019
- BERA findings:
  - Benthic invertebrates (including crabs and mussels) are at risk from elevated dioxins, PCBs, PAHs, pesticides, and metals in sediment.
  - **Fish** (omnivores, invertivores, and piscivores) are at risk through fish tissue, fish eggs, dietary dose, and surface water exposure to dioxins, PCBs, pesticides, and metals in surface water.
  - Birds (sandpiper, heron, and kingfisher) are at risk through dietary dose and egg tissue exposure to dioxins, PCBs, PAHs, pesticides, and metals in sediment.
  - Mammals (river otter and mink) are at risk through dietary dose exposure to dioxins, and PCBs in sediment.



# **Ecological Risk**

The Final BERA states that the contaminants that contribute the greatest ecological risk are:

- 2,3,7,8-TCDD
- PCDD/PCDF TEQ (based on fish-TEQ, bird-TEQ, and mammal-TEQ)
- Total TEQ (based on fish-TEQ, bird-TEQ, and mammal-TEQ)
- Total PCBs
- PCB (based on fish-TEQ, bird-TEQ, and mammal-TEQ)
- Total DDx



# **Feasibility Study**



### Remedial Action Objectives

CSTAG 2018 Recommendation #2a %SWAC reduction and #4 clear reaches

#### **RAO 1—Addressing Surface Sediment Source Areas**

- Control the sediment sources of dioxin and total PCBs by remediating surface sediment source areas containing elevated concentrations, thereby reducing the surface-weighted average concentration (SWACs) of dioxin and total PCBs from river mile (RM) 8.3 to RM 15.
- Achieve a post-IR dioxin SWAC from RM 8.3 to RM 15 of not more than 85 ppt, approximately an order of magnitude higher than the Operable Unit 2 (i.e., the lower 8.3 miles of the LPRSA) dioxin sediment remediation goal of 8.3 ppt, and achieve a post-IR total PCB SWAC from RM 8.3 to RM 15 that is at or below the established total PCB background concentration of 0.46 ppm.

#### **RAO 2—Addressing Subsurface Sediment Source Areas**

 Control subsurface sediments (sediments deeper than 6 inches below the sediment bed) from becoming sources of dioxin and total PCBs by remediating sediments between RM 8.3 and RM 15 that have a demonstrated potential for erosion to expose subsurface concentrations above the defined subsurface remedial action levels (RALs) established for dioxin and total PCBs.



## **Interim Remedy in the Upper-9 Miles**

#### Foundation

 Source Control- areas with elevated contaminant concentrations that represent significant exposure to the local biota, that contribute contamination to the water column and throughout the LPR through erosion and deposition, and that inhibit recovery of the system

#### Action

- Remove sediment source areas, focusing on 2,3,7,8-TCDD and total PCBs as contaminants of concern
- SWAC-based goals would be used to determine if the sediment sources have been removed
- IR would be accomplished by removing sediment with contaminant concentrations greater than RALs needed to attain target SWACs
- Pre-design Investigation data will be used to identify the sediment source areas
- Adaptive Management Plan provide a management framework for identifying critical uncertainties, collecting information to reduce those uncertainties, and interpreting and responding to new data and any updates to the CSM.



## **Interim Remedy in the Upper-9 Miles**

#### Intended Response

- Remove highest concentrations and achieve substantial reduction in average concentrations to reduce exposure
- Allow areas with net deposition (good recovery potential) to respond to the substantial reduction in concentrations achieved by remediating source areas
- Allow areas subject to cyclical erosion and deposition to respond to the substantial reduction, although more slowly
- RALs will be set at design

CSTAG 2018 Recommendation #2b RALs come after PDI



#### **Definition of Source**

#### CPG's Draft IR FS:

"Sediment and surface water data collected during the RI and post-remediation data collected in the RM 10.9 Removal Action area suggest reasonable thresholds for classifying source sediments are 2,3,7,8-TCDD concentrations above about 300 ng/kg and total PCBs above 1 mg/kg."

- EPA's Suggested Revision for Source Sediment:
- Represent significant exposure to biota, and/or have a low potential for recovery and inhibit overall recovery in the system
- 2,3,7,8-TCDD and/or total PCB concentrations in ranges that are closely associated with current water column particulate concentrations
- Addressing source sediments would reduce concentrations on suspended water column particulates (and also reduce exposure to biota), which would in turn reduce concentrations in surface sediments where water column particulates are deposited, accelerating system recovery
- Operational definition: sediments with concentrations of 2,3,7,8-TCDD and/or total PCBs in excess of the RALs required to attain target SWACs. If an IR is implemented, source sediments would be defined during design based on the selected target SWACs, pre-design sediment sampling data, and associated RALs.



#### **FS Alternatives**

- Alternative 1: No action
- Alternatives 2-5: Remediate sediment from RM 8.3 to RM 15 to attain a post-IR 2,3,7,8-TCDD SWAC, with PCB RALs

Alternative	2,3,7,8-TCDD Target SWAC	PCB RAL
Alternative 2	85 ppt	1 ppm
Alternative 3	75 ppt	1 ppm
Alternative 4	65 ppt	1 ppm
Alternative 5	125 ppt	No PCB RAL

CSTAG 2018 Recommendation #3a Different SWAC alternatives



#### **FS Alternatives – Common Elements**

- Sediment removal (2-3 ft)
  - Mechanical dredging
  - Land-based removal where necessary
- Dredged material management
  - Barge dewatering
  - Off-site processing facility
- Residuals mitigation
  - BMPs
  - Capping
    - Isolation layer, armoring, breakthrough modeling
- MNR and monitoring
  - IR completion, O&M, LTM
- ICs
  - Use restrictions, easements, advisories
- Habitat Restoration

CSTAG 2018 Recommendation #5 RM10.9 Lessons Learned



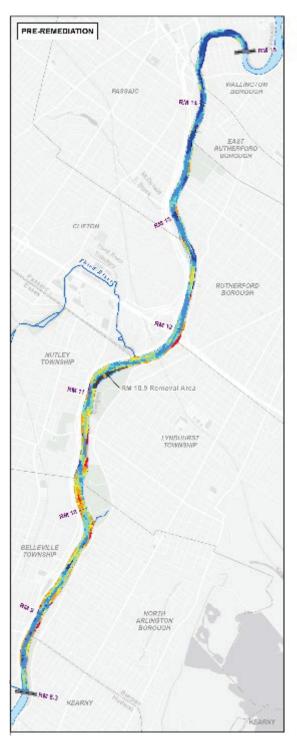
### **Remediation Considerations for Design**

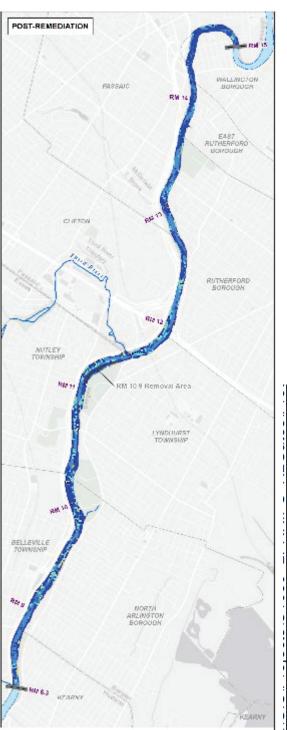
- Dredging to clean depth
  - Feasibility and incremental effort/cost
- Dredging and dredged material management techniques
  - Synergy with Lower 8 (e.g., hydraulic vs. mechanical dredging)
- Application of different RALs/SWACs to different areas
  - Fish forage or other discrete exposure areas

CSTAG 2018 Recommendation #3b Consider Hydraulic Dredging CSTAG 2018 Recommendation #4b Consider SWACs across Smaller Regions CSTAG 2018 Recommendation #9a Implement PDI to Evaluate Clean Depth

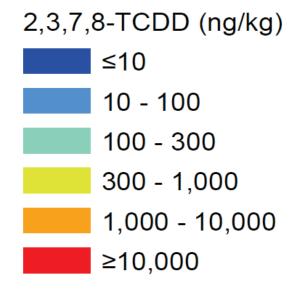


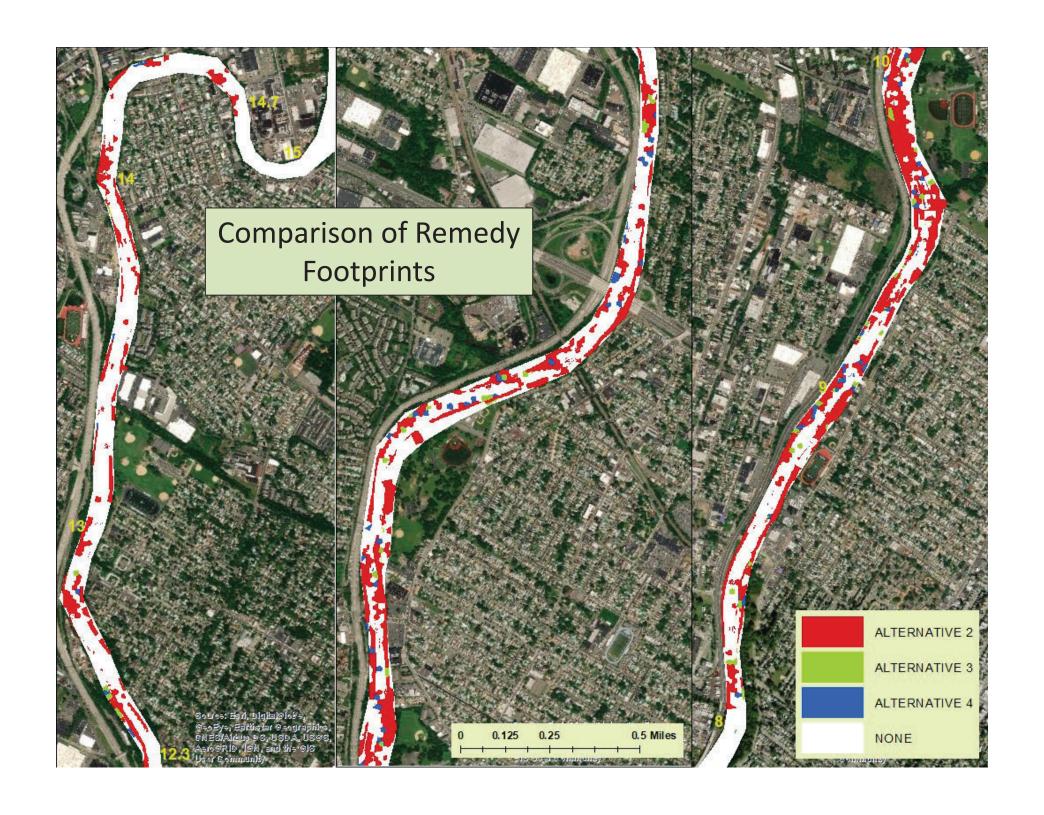
TABLE 1 - SUMMARY OF KEY CHARACTERISTICS OF IR ALTERNATIVES										
Alt	Dioxi n RAL (ppt)	PCB RAL (ppm)	Post-IR Dioxin SWAC (ppt) and % Reduction from Current	Post-IR PCB SWAC (ppm) and % Reduction from Current	Area of Remediation Footprint (acres)	Volume of Dredged Sediment (cy)	Construction Duration (years)	Cost (\$M)		
1			932 (0%)	2 (0%)	0	0		0		
2 (85)	260	1	80 (91%)	0.44 (78%)	90	363,000	4.3	412		
3 (75)	205	1	70 (92%)	0.41 (80%)	96	387,000	4.6	433		
4 (65)	165	1	60 (94%)	0.39 (81%)	104	419,000	4.9	460		
5	346		121 (87%)	0.62 (69%)	62	250,000	3.2	314		





Example of Footprint from draft FS (Alternative 3)







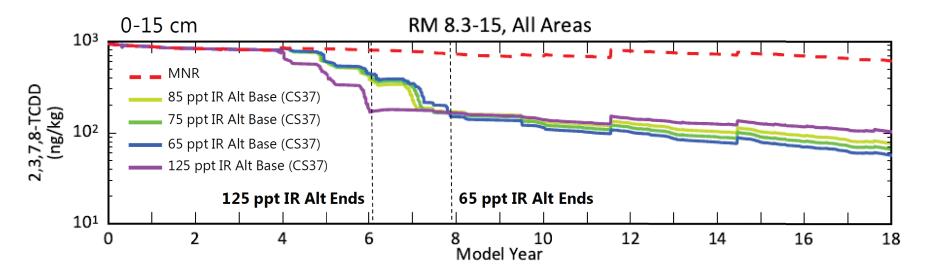
### **Draft FS Alternatives Comparisons**

The following slides (see handouts) are taken directly from the CPG's *draft Upper 9-Mile Source Control Interim Remedy Feasibility Study* dated August 12, 2019S. Note that EPA Region 2 has a number of comments on this table, for example, the EPA does not assign "no action" alternative a favorable rating for short term effectiveness.

TABLE 2 – SUMMARY OF COMPARATIVE ANALYSIS OF IR ALTERNATIVES								
Key Metrics Summary	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Explanation of Ranking		
Alternative (2,3,7,8-TCDD	NA	85 ppt	75 ppt	65 ppt	125 ppt			
Dioxin SWAC achieved (ppt) <sup>1</sup>		80	70	60	121			
Total PCB SWAC achieved (ppm)		0.44	0.41	0.39				
Area of removal (acres)		90	96	104	62			
Volume of removal (cubic yards)		363,000	387,000	419,000	250,000			
Mass of 2,3,7,8-TCDD removed (grams)		800	820	840	700			
Mass of total PCBs removed (kilograms)		1,090	1,120	1,150	800			
Construction duration (years)		4.3	4.6	4.9	3.2			
Overall Protection of Human Health and the Environment	No	Yes	Yes	Yes	No	Yes = achieves the metrics for this threshold criterion No = does not achieve the metrics for this threshold criterion.		
2. Compliance with ARARs		Yes	Yes	Yes	Yes	Yes = meets this threshold criterion.		
3. Long-Term Effectiveness and Permanence		<b>√√</b> √	<b>*</b> **	<b>√√√</b>	<b>√</b> √	A higher ranking (more checks) indicates the degree to which this balancing criterion is achieved based on the submetrics.		
Source Control		<b>///</b>	<b>///</b>	<b>///</b>	<b>√</b>	A higher ranking (more checks) indicates the degree to which sources are addressed.  Dependent on the RAL.		
Cap Stability		<b>V V</b>	<b>777</b>	<b>777</b>	<b>V V</b>	The active alternatives achieve a stable cap to the same degree.  Identical cap design criteria.		

	TABL	E 2 – SUMMAR	Y OF COMPAR	RATIVE ANALYSI	S OF IR ALTERNA	ATIVES
Key Metrics Summary	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Explanation of Ranking
Alternative (2,3,7,8-TCDD	NA	85 ppt	75 ppt	65 ppt	125 ppt	
Monitoring, Maintenance,		<b>V V V</b>	<b>V V V</b>	<b>V V V</b>	<b>V</b>	The active alternatives require the same
and Institutional Controls						degree of monitoring and maintenance; a
						higher ranking indicates the possibility
						that institutional controls (specifically fish
						consumption advisories) may be revised
						when remedial goals are achieved.
						Dependent on the RAL.
Recovery Potential		<b>V V</b>	<b>V V</b>	<b>V V</b>	<b>√</b>	A higher ranking indicates a higher potential for recovery following source control.  Dependent on the RAL.
4. Reduction of Toxicity, Mobility, or Volume through Treatment		<b>V</b> V	<b>V V</b>	V V V	<b>√</b>	A higher ranking indicates a higher volume of sediment that is addressed through reduction of mobility and treatment.  Dependent on contaminant mass removed.
5. Short-Term Effectiveness	<b>~</b>	<b>V V V</b>	VVV	<b>√</b> √	✓	A higher ranking indicates the degree to which this balancing criterion is achieved based on the sub-metrics.
Time to Achieve RAOs		<b>√√</b>	<b>√√√</b>	<b>√√√</b>		It is assumed that post-construction certification process will take approx 3 years, and Alternatives 2, 3, and 4 will achieve the RAOs 7-8 years following the start of construction. Alternatives 1 and 5 do not achieve RAOs.  Dependent on duration.
Worker Risk and	<b>√√√√</b>	<b>√√√</b>	<b>√</b> √	✓	$\checkmark\checkmark\checkmark$	A higher ranking indicates higher
Community Impact						performance, i.e., lower risk and impact.  Dependent on duration.
Resuspension		√ √	<b>√</b> √	<b>~ ~</b>	<b>√</b> √	The projections of the active alternatives show approximately the same level of resuspension.  Dependent on the contaminant mass removed.

# Comparison of Alternatives For CS 37 Without Remedy ST



#### Lessons Learned:

- 85, 75 & 65 ppt alternatives follow similar tracks
- 125 ppt alternative yields slower recovery
- Release of dredged material controls initial postremedy concentrations



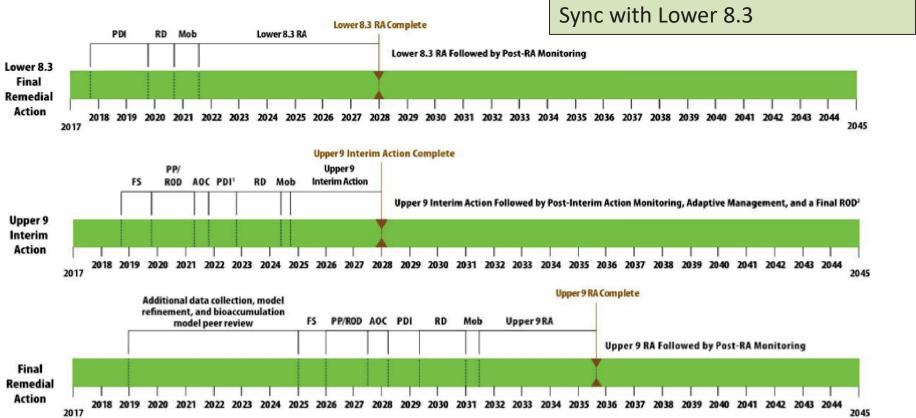
# **Interim Remedy**





#### **Interim Remedy Schedule**

CSTAG 2018 Recommendation #10 Sync with Lower 8.3



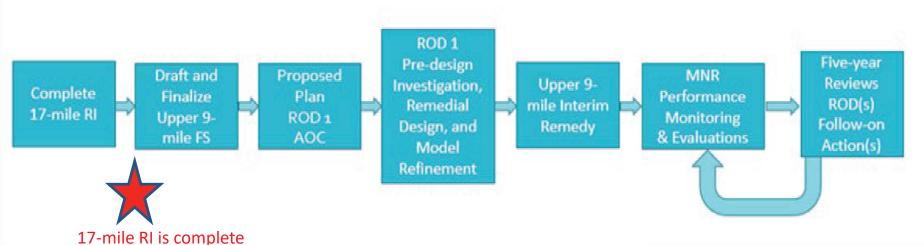
Prior to the interim action PDI, baseline monitoring would also be implemented consistent with CSTAG recommendations.

<sup>&</sup>lt;sup>3</sup>Adaptive management would include interim action performance assessment, model refinement, and modeling of recovery rates to facilitate derivation of risk-based goals and completion and implementation of the final ROD.



### **Upper 9 Mile Interim Remedy**

Upper 9-mile Plan – An Adaptive & Iterative Approach

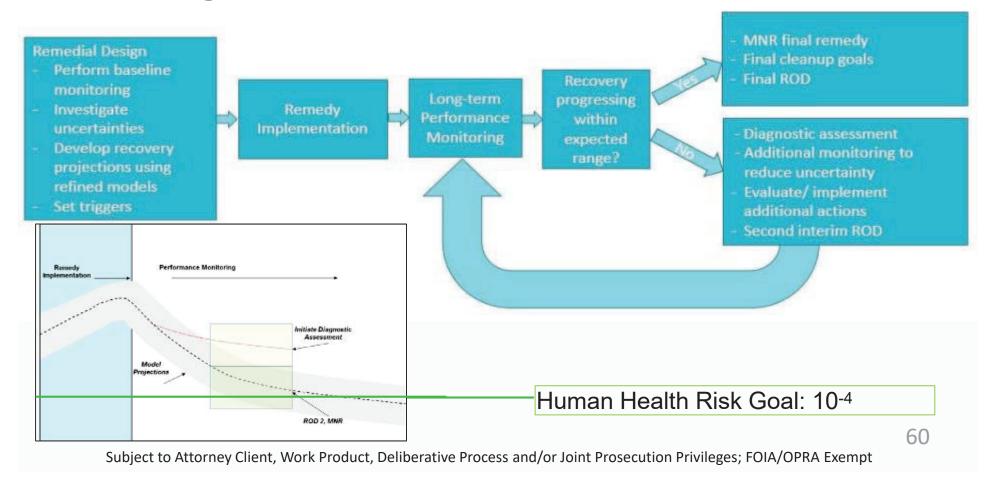


and EPA is reviewing the Draft Interim Remedy FS

CSTAG 2018 Recommendation #1b Ensure moving toward final ROD

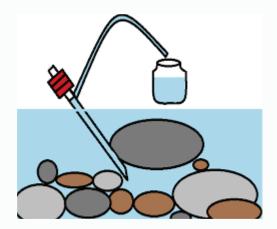


# **CPG's Proposed Upper 9 Mile Iterative Management Process**





# **Interim Remedy Monitoring**





### **Interim Remedy Monitoring**

- Current Condition Monitoring
  - Establish pre-interim action conditions
    - Bathymetry survey
    - Physical and Chemical Water Column and Biota
- Pre-Design Investigation
  - 80-foot grid spacing plus in fill sampling
- Construction Interim Remedy Monitoring Performance
  - Assess best management practices (BMPs) and performance during action
    - Physical and Chemical Water Column
    - Bathymetry
- Performance
  - Bathymetry, Water Column, Biota, Sediment
    - SWAC achievement
    - Long Term
      - Primary: Bathymetry, Water Column, Biota
      - Diagnostic: Water Column, Biota, Sediment
  - Conduct Operation and Maintenance (O&M)
    - Cap integrity and performance

CSTAG 2018 Recommendation #7a adequate baseline data and #7b LTM data towards recovery and final cleanup



### **Bathymetry Data**

- CPG performed three mobilizations to complete a comprehensive bathymetric survey between Feb and Apr 2019
  - Mob 1 multi-beam, side-scan sonar, and aerial LiDAR surveys (Feb 2019)
  - Mob 2 single-beam and side-scan sonar surveys (Mar 2019)
  - Mob 3 sediment ground-truthing (Apr 2019)
- Survey data merged and interpolated to provide continuous bathymetric and sidescan sonar coverage from approximately RM 8 (W Railroad Drawbridge) to RM 16 (Monroe St Bridge)

CSTAG 2018 Recommendation #9b More bathymetry data



# **Current Condition Sampling Biota**

		s - Target Size Only		
Species	Area A	Area B	Target Size (mm)	Total No.
American eel	6	10	400-600	16
Bass (smallmouth bass)	11	8	200-300	19
Blue crab	8	0	125-145	8
Catfish (channel catfish, white catfish)	6	2	400-500	8
Common carp	12	12	500-600	24
Sunfish (bluegill, pumpkinseed, redbreast sunfish)	12	12	100-140 (prioritized > 110 mm where possible)	24
White perch	12	12	150-200	24



# **Current Condition Sampling Surface Water**

Program	Condition	Flow at Dundee Dam (cfs)	Tidal Range (ft)	Desired No. of Events	Results	Notes	
	Low Flow	<300	(NA)	1	1/1 Complete	Flows should be in	
Physical Water	Moderate Flow	>300 and <600	(NA)	1	1/1 Complete	the targeted range for 7 days	
Column Monitoring	Moderately High Flow	>600	(NA)	1	1/1 Complete	antecedent to the survey	
	High Flow	>5000	(NA)	1	0	No antecedent flow requirement	
	Salt front possibly reaching RM 10	< 300	6-7	2	2/2 Complete	Low antecedent flows	
Chemical Water	Salt front possibly reaching RM 8	300-600	4-5/6-7	4	3/4	Low antecedent flows	
Column Monitoring	Salt front in Lower 8 miles	> 600	4-5/6-7	2	1/2	Pick significantly different flows	
	High flow scouring parent bed	> 5,000	Any	1	0	No antecedent flow requirement	



### **Pre-Design Investigation**

- To achieve accurate mapping, a multi-stage Pre-Design Investigation (PDI) will be conducted.
  - The first stage will consist of sediment sampling on a fixed grid nominally spaced at 80-feet on center from RM 8.3 to RM 15
  - Additional rounds of PDI sediment sampling will be conducted to address areas where the remediation footprint boundaries are most uncertain and where geostatistical interpolation could be improved with a more fulsome dataset to refine the remediation footprint

CSTAG 2018 Recommendation #9a specific sampling depth for PDI and "dredge to clean"



## **CPG's Proposed PDI and Monitoring**

		Bathymetry	Water Column	Biota	Sediment (Recovery Indicator Areas)
PDI/Baseline		√	V	V	<b>V</b> **
Remedy Implementation			V	V	
Year 0 Post Construction		√	√	√	√
Long- term	Primary*	<b>v</b>	√	√	
	Diagnostic		<b>v</b>	<b>v</b>	√

<sup>\*</sup> Primary components are those identified as triggering metrics

<sup>\*\*</sup> Sediment sampling will be performed in PDI



# **Interim Remedy Completion**



# Interim Remedy Completion Assessment Purpose

- Gather and assess multiple lines of evidence regarding success/completion of interim remedy
- Declare a successful interim remedy a success
- Do not declare an unsuccessful interim remedy a success
  - Possibly declare interim remedy complete by way of multiple lines of evidence assessment
- Support transition to longer-term monitoring towards final risk-based cleanup decision (final ROD)



# Interim Remedy Completion Assessment Multiple Lines of Evidence

- Pre-interim remedy lines of evidence
  - Current conditions sampling and PDI
  - Interim remedy design
- Interim remedy lines of evidence
  - BMPs, performance monitoring, oversight, and certification process
- Post-interim remedy lines of evidence
  - Sediment sampling and statistical data analysis
  - Assessment of remaining source areas



### Interim Remedy Completion Assessment Pre-Interim Remedy Lines of Evidence

- Current Conditions Sampling
  - At least two comprehensive bathymetry surveys improve understanding of hydrodynamics, including erosion
  - Baseline surface water data inform performance monitoring approach
- PDI
  - High-density spatial coverage (8 cores/acre) improve understanding of contaminant distribution
  - Potential infill sampling at higher density delineate areas of contamination, reduce data variability as needed
  - Revised conditional simulation improved accuracy in interpolation



# Interim Remedy Completion Assessment Pre-Interim Remedy Lines of Evidence (cont'd)

- Interim Remedy Design
  - Conservative approach to developing remediation footprint — sequential application of RAO1 followed by RAO2, erosional areas based on data, subsurface RALs based on evaluation of bathymetry data and erosion potential, manual adjustment
  - Treatment of RM 10.9 area incorporate into design footprint (along with other challenging areas)
  - Incorporate refined models increased confidence in assumptions re: recontamination potential



# Interim Remedy Completion Assessment Interim Remedy Lines of Evidence

- BMPs
  - Robust BMP program control in-river impacts of interim remedy
- Performance Monitoring
  - Performance monitoring plan measures and thresholds (e.g., surface water quality, dredge cut accuracy, contaminant mass removal efficiency, cap placement accuracy)
  - Contingency measures address non-compliance
- Oversight
  - Continuous EPA oversight direct and indirect (oversight of planning, data compilation/interpretation, and reporting elements) oversight
- Certification Process
  - EPA certification of construction by finite construction unit and/or comprehensively for footprint



## Interim Remedy Completion Assessment Post-Interim Remedy Lines of Evidence

- Post-Interim Remedy Sediment Sampling and Statistical Analysis
  - Probability-based sampling design sufficient number of samples (anticipated to be not less than 400)
  - Calculate SWAC and confidence interval 95UCL and 95LCL
  - Evaluate remedy performance assess data from perspective of performance, as supplement to performance monitoring data
  - Apply statistical evaluation framework account for inherent uncertainty in calculating SWACs as well as tolerances for false negative and false positive outcomes



# Interim Remedy Completion Assessment Post-Interim Remedy Lines of Evidence (cont'd)

- Remaining Actionable Source Assessment
  - Evaluate potential presence of remaining source areas sediment concentrations in comparison to RALs, physical distribution of concentrations exceeding RALs, occurrence of RAL exceedances in in-situ vs deposited sediments and in remediated vs unremediated areas
  - Evaluate expected benefit of removing any residual source area(s) – potential for substantive improvement in interim remedy outcome
  - Evaluate feasibility of removing any residual source area(s)
    - construction or logistical constraints



## Interim Remedy Completion Assessment General Approach

- STEP 1: Gather information
  - Perform current conditions sampling and PDI
    - Revise conditional simulation mapping and refine models
  - Complete interim remedy design
  - Implement interim remedy and associated BMPs, performance monitoring, oversight, and certification
  - Collect post-interim remedy sediment sampling data
- STEP 2: Interpret information
  - Apply statistical evaluation framework to post-interim remedy sediment sampling data
  - Assess potential for remaining source areas
  - Evaluate all lines of evidence collectively
- STEP 3: Derive conclusion re: interim remedy success/completion

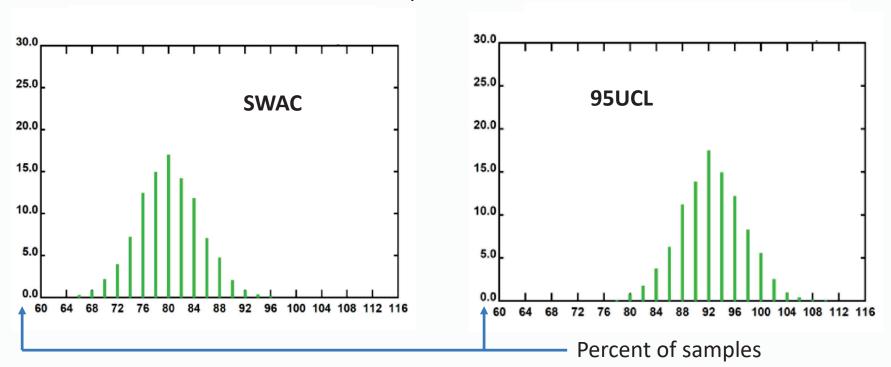


**Uncertainty in Interpolated Concentrations** 

2,3,7,8-TCDD SWAC Target	100 CS Map Range 2,3,7,8-TCDD RAL (ppt)	100 CS Map Range Acreage	
85 ppt	<b>183-352</b> (260)	<b>74-106</b> (90)	
75 ppt	<b>144-275</b> (205)	<b>79-115</b> (96)	
65 ppt	<b>115-212</b> (164)	<b>87-122</b> (104)	
C	S37		



Uncertainty in Calculated SWAC



2,000 simulated samplings (600 samples each) from an underlying data population with a true mean of 80 ppt



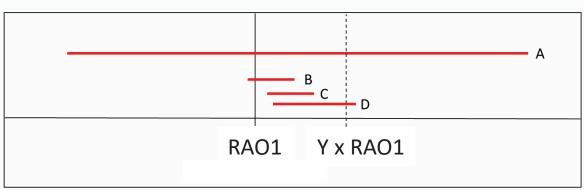
- Confirmation program intended to provide information to confidently conclude source control action was successful, when it was successful
  - EPA guidance supports application of reverse null statistical framework and testing against 95UCL
- Incorporate inherent uncertainty in calculated SWACs and establish factor (Y) that defines a compliance threshold below which it can be concluded that calculated SWACs are not materially different from RAO1 goals
  - Y can be established to ensure only a small likelihood of judging successful IR to have been unsuccessful (false negative)
  - Y can also be established to limit likelihood of concluding an unsuccessful IR was successful (false positive)



- Why not compare 95UCLs directly to RAO1 goals?
  - When the true mean is X there is a 5% chance the UCL is less than X
    - The RAO1 goals would be the upper limit of acceptable outcomes
    - In contrast the IR is intended to achieve the RAO1 goals
    - Direct comparison to the RAO1 goals would require designing the remedy to lower post-IR SWAC – just to allow for variability in the sample mean
  - For total PCBs, similar logic applies and additionally:
    - Background concentrations are limiting
    - Designing to less than background would be unreasonable
    - Requiring the UCL to be less than background is virtually impossible



Potential Post-IR Scenarios

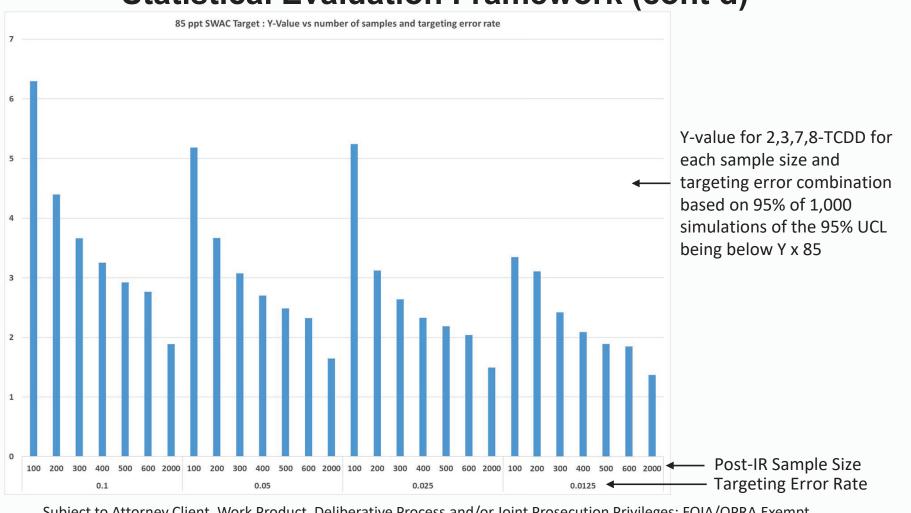


4	Scenario	cenario D: LCL > RAO1 and UCL > Y times RAO1		
F T	Approach	Decision		
	Traditional Null	IR not successful because LCL > RAO1 (95% certain SWAC > RAO – even if only a little)		
	Reverse Null with Y	IR not successful because UCL > Y times RAO1 (not certain SWAC is materially similar to RAO)		



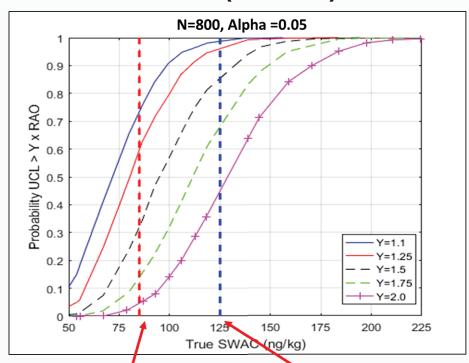
- General approach to deriving Y for 2,3,7,8-TCDD (using RI data)
  - Simulate three post-interim remedy data populations, scaled to have an overall mean of 85 ppt 2,3,7,8-TCDD
    - Remediated areas with uniform concentration of 10 ppt 2,3,7,8-TCDD (recontamination)
    - Correctly not remediated areas with concentrations like RI data but truncated at RAL
    - Incorrectly not remediated areas with concentrations like RI data within areas that were remediated
  - Select ranges of targeting error rate and post-interim remedy sample size
  - Simulate many samples with these assumptions and calculate 95UCLs
  - Identify upper bound for which 95% of UCLs are less than compliance threshold; (controls false negative error rate at 5%)
  - $Y = upper bound \div 85$  (the RAO1 goal of 85 ppt)







- Probability of declaring failure
  - For fixed Y and sample size, N, probability increases with true SWAC
  - Probability increases with decreasing Y
  - For Y = 1.1 and N = 800, 75%
     chance of declaring failure
     (falsely) when true SWAC = 85 ppt
  - For Y = 2.0 and N = 800, 45%
     chance of declaring failure when
     true SWAC = 125 ppt

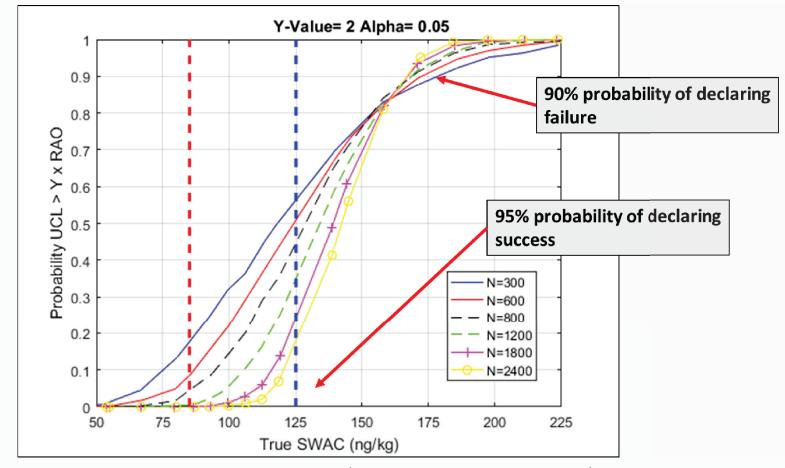


True SWAC = 85 ppt
Should have high likelihood
of concluding RAO1 was met

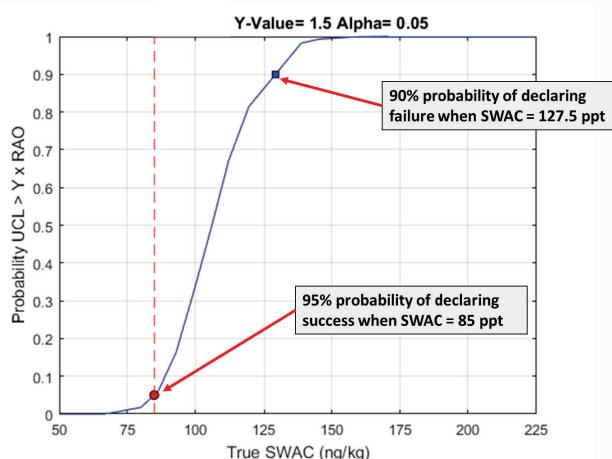
True SWAC >> 85 ppt
Should have high likelihood of concluding RAO1 was not met



Decision error rates vary with N







Iterate Y and N to find optimal solution (shown = 800 sampling locations with 3-pt composites)

Y to be derived after PDI data are available

Y may differ for 2,3,7,8-TCDD and total PCBs



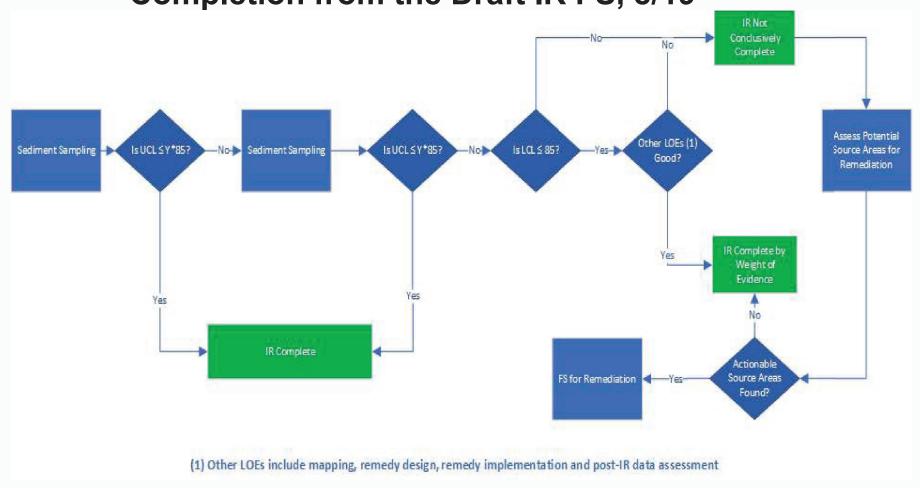
- Application of compliance threshold approach
  - Calculate post-interim remedy SWACs and 95% confidence intervals from post-interim remedy sediment sampling data
  - Compare 95UCLs of calculated SWACs to compliance thresholds
    - If 95UCLs <= compliance thresholds, interim remedy successful</li>
    - If 95UCL > compliance threshold, evaluate 95LCL
      - If 95LCL > RAO1 goal, interim remedy not successful
      - If 95LCL < RAO1 goal, interim remedy success indeterminate</li>
      - Perform follow-on actions



- Follow-on actions for not successful or success indeterminate outcomes
  - Collect additional data and evaluate recalculated SWACs and 95% confidence intervals
    - If 95UCLs <= compliance thresholds, interim remedy successful</li>
    - If 95UCLs not <= compliance thresholds, but there are no remaining actionable sources, interim remedy deemed complete
    - If 95UCLs not <= compliance thresholds, and there are remaining actionable sources, the remaining actionable sources would be removed before the interim remedy is deemed complete
- If, after PDI data are collected, the statistical evaluation framework no longer appears reasonable, it will be replaced with a different framework



## CPG's Proposed Approach for Assessing Interim Remedy Completion from the Draft IR FS, 8/19





## **Adaptive Management**



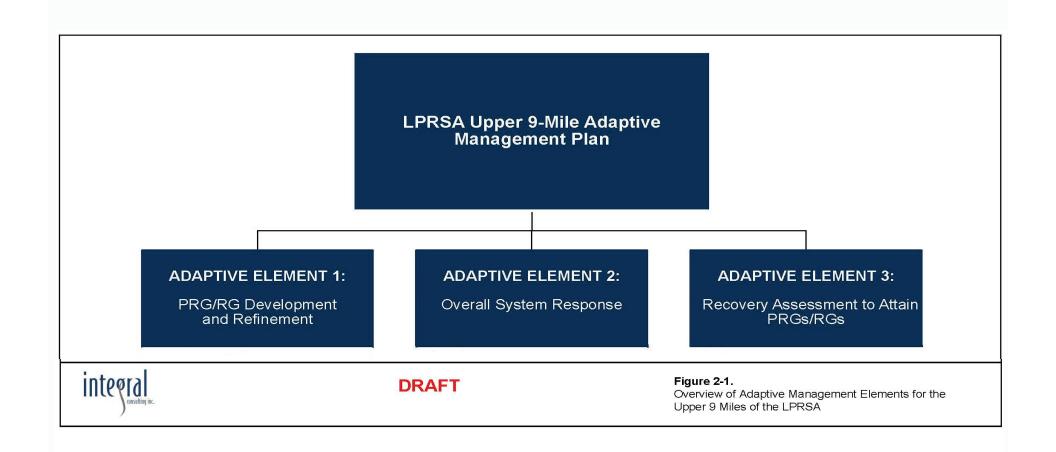
## **Adaptive Management**

Adaptive management principles will be applied to interim remedy process

- CPG submitted Appendix D of the Draft FS that outlines the Adaptive Management Plan
- New information will be used to maximize the success of the project throughout development, design, implementation, and post-interim remedy monitoring
- Data collected once the interim remedy is completed will be used to determine if any further in-river work is needed, or if risk has been addressed by the interim remedy
- Note, the CPG has not agreed to implement an interim remedy, therefore, the Adaptive Management Plan is just a conceptual starting point



## **CPG's Draft Adaptive Management Plan**





## **CPG's Draft Adaptive Management Plan**

LPRSA Upper 9-Mile Adaptive Management Plan

### **ADAPTIVE ELEMENT 1:**

PRG/RG Development and Refinement

### **Decision question:**

Is uncertainty in the key variables that influence PRGs adequately constrained so that selection of a final remedy will achieve the remedial goals in an efficient manner?

### **ADAPTIVE ELEMENT 2:**

Overall System Response

### **Decision question:**

Is the response of the system to the source control IR consistent with the CSM and numerical models?

### **ADAPTIVE ELEMENT 3:**

Recovery Assessment to Attain PRGs/RGs

#### **Decision question:**

Is recovery progressing in media of concern to reach protective levels of risk-driving COCs within a reasonable timeframe?



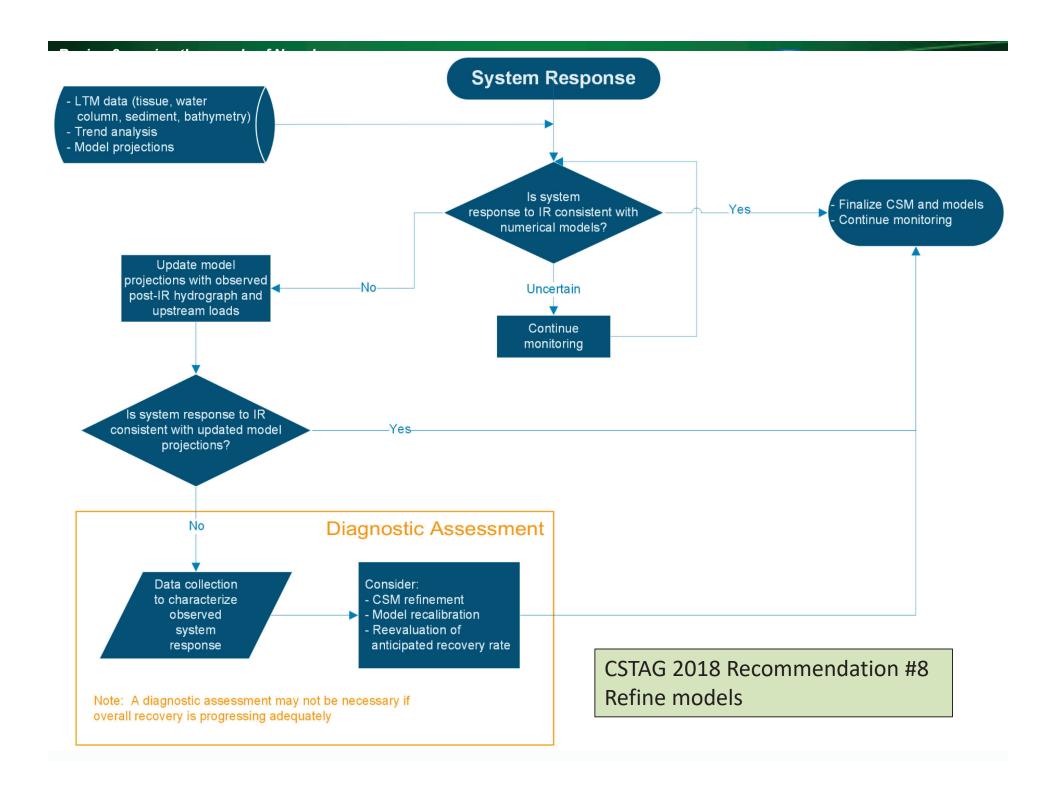
**DRAFT** 

Figure 2-1.

Overview of Adaptive Management Elements for the Upper 9 Miles of the LPRSA

		Adaptive Management Elements			
Key Uncertainties	Phase	Identified Uncertainties	ELEMENT 1 PRG/RG Development and Refinement	ELEMENT 2 Overall System Response	Recovery Assessment to Attain PRGs/RGs
	Remedial Design	<ul> <li>Pre-IR Baseline Conditions</li> <li>Spatial Distribution of Sources</li> <li>SWACs</li> <li>Model Frameworks and Parameterization</li> <li>High Flow Erosion</li> </ul>	<b>✓</b>	✓	<b>✓</b>
	Interim Remedy Implementation and Completion	<ul> <li>Constructability</li> <li>Effectiveness of BMPs</li> <li>Impact of Lower 8-Mile</li> <li>Remedy on the Upper 9 Miles</li> <li>SWAC Attainment</li> </ul>		✓	<b>✓</b>
	Post-Interim Remedy Monitoring and Adaptive Management	<ul><li>Ranges of working PRGs</li><li>System Response to IR</li><li>Recovery</li></ul>	✓	✓	✓
	Development and Implementation of Final ROD	<ul> <li>Final RGs</li> <li>Sufficiency of MNR</li> <li>Construction Completion and NFA</li> <li>Technical Impracticability Waiver</li> </ul>	<b>✓</b>		<b>✓</b>







## **EPA's Issues on Adaptive Management Appendix**

- PRGs should not be developed as ranges but rather as point estimates.
- PRGs should be developed for sediment, and in a manner that considers the relationships between sediment concentrations and fish tissue concentrations.
- The decision time frames for the adaptive elements should not be constrained to the five-year review process.
- If the refined model, incorporating the current conditions and PDI data, does not forecast the desired response to the IR, there should be a pathway within the Plan to address this unresolved inconsistency between the CSM and model before moving forward with remedy implementation.
- The Plan alludes to future revisions that may be incorporated during RD and post-IR performance monitoring. The Plan should convey the boundaries around the revisions that might be made.
- IR is the first step of adaptive management and plan should focus more on how to proceed after IR completion.



## Region 2 is requesting CSTAG's feedback on the following items:

- 1. Region 2 suggested these additional metrics for the alternatives in our comment set to CPG and would like input from CSTAG:
  - Implications for remediating sediments in the RM 10.9 area, where previous removal has occurred, and an armored cap is in place
  - Total mass (2,3,7,8-TCDD and total PCBs) reduction in the system relative to prior estimates of total mass from the RI.
  - Comparison of the relative effect of upper 9-mile FS alternatives on the lower 8-mile average 2,3,7,8-TCDD and total PCB concentrations.
  - Average contaminant concentrations in (2,3,7,8-TCDD and total PCBs) the IR footprint and in the incremental area/volume addressed by successively larger footprints.



## Region 2 is requesting CSTAG's feedback on the following items: (continued)

- The relationship of alternative cost to other measures, potentially including contaminant mass removed, SWACs achieved, and/or other pertinent factors
- CPG suggested adding:
  - Gross erosion flux
  - Net downstream load at RM 8.3



# Region 2 is requesting CSTAG's feedback on the following items: (continued)

- 2. IR details:
  - Definition of source
  - Derivation of footprint
  - Leaving certain considerations to design, after Current Condition
     Sampling and PDI are done
- 3. Determination of IR completion
  - Tolerance for errors
  - Incorporation of uncertainty through Y and derivation of Y
  - Decision outcomes and follow on actions
  - Weighting of LOEs
- 4. Adaptive management
  - PRGs as ranges
  - Specific decision questions



### **Questions** ?????

